Space Weather Technical Forecast

Issued on Wednesday 4 December 2024 at 12:04 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low to Moderate over the past 24 hours, with an isolated M-class flare peaking at M2.3 at 04/1001 UTC from a region just beyond the east limb.

There are currently nine sunspot regions on the Earth-facing disc. AR3905 and AR3906 are both increasingly difficult to analyse as they approach the southwest limb, and have given occasional C-class flares. AR3912, now approaching the south-centre disc remains relatively simple, with little change in recent imagery. Some slight development was observed in AR3913, to the west of AR3912, with the growth of a weak trailer spots, while new small spots also emerged to the southeast of AR3910, in the north-centre disc. The most notable regions however, are likely to be the new regions rotating around the southeast limb, associated with more notable magnetic looping on imagery, and with the westernmost of these numbered AR3916. These remain very difficult to assess accurately due to their proximity to the limb, but showing some potential for complexity which is may become more apparent as they move into a less oblique viewing angle.

No Earth-directed CMEs have been observed, however there are a number of filaments on the Earth-facing disc, including a large north-south filament on the east disc, which will be monitored for any potential lift off. A small filament was observed lifting off from the northeast quadrant beginning around 04/0400 UTC, however updated coronagraph imagery is required to determine if any associated CME was produced.

Solar Wind / Geomagnetic Activity: The ongoing passage of a weak, glancing CME was observed, arriving around 02/2000 UTC, likely from a filament eruption on 27 Nov. Solar wind speeds were predominantly slightly elevated and showed a gradual, albeit erratic, rising trend through the period, with a recent brief peak of 540km/s. The density fluctuated between average and above average levels until after 03/1700 UTC when it settled largely around average. Interplanetary Magnetic Field (IMF) strength, Bt, was occasionally Moderate with several peaks around 11nT, between 031500-04/0330 UTC, otherwise Weak. The north-south component was Weakly variable between +8nT and -7nT. Phi angle was positive (away from the Sun) between 03/1330-1700 UTC, otherwise negative (toward the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at Background. High energy electron flux (greater than 2MeV) observed by GOES16 was Background.

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The associated 24-hour fluence was below Active. The 04/0000 UTC observation was 1.57e6 total pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Mostly Low activity is expected with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. There are no coronal holes fast wind connections expected through the period, with slightly elevated winds easing to be mainly background. Geomagnetic activity is forecast to be Quiet with isolated Unsettled intervals.

Energetic Particles / Solar Radiation: High energy protons are expected to persist at background. High energy electron flux is expected to persist mainly at background with the associated 24 hour fluence remaining below the Active threshold.

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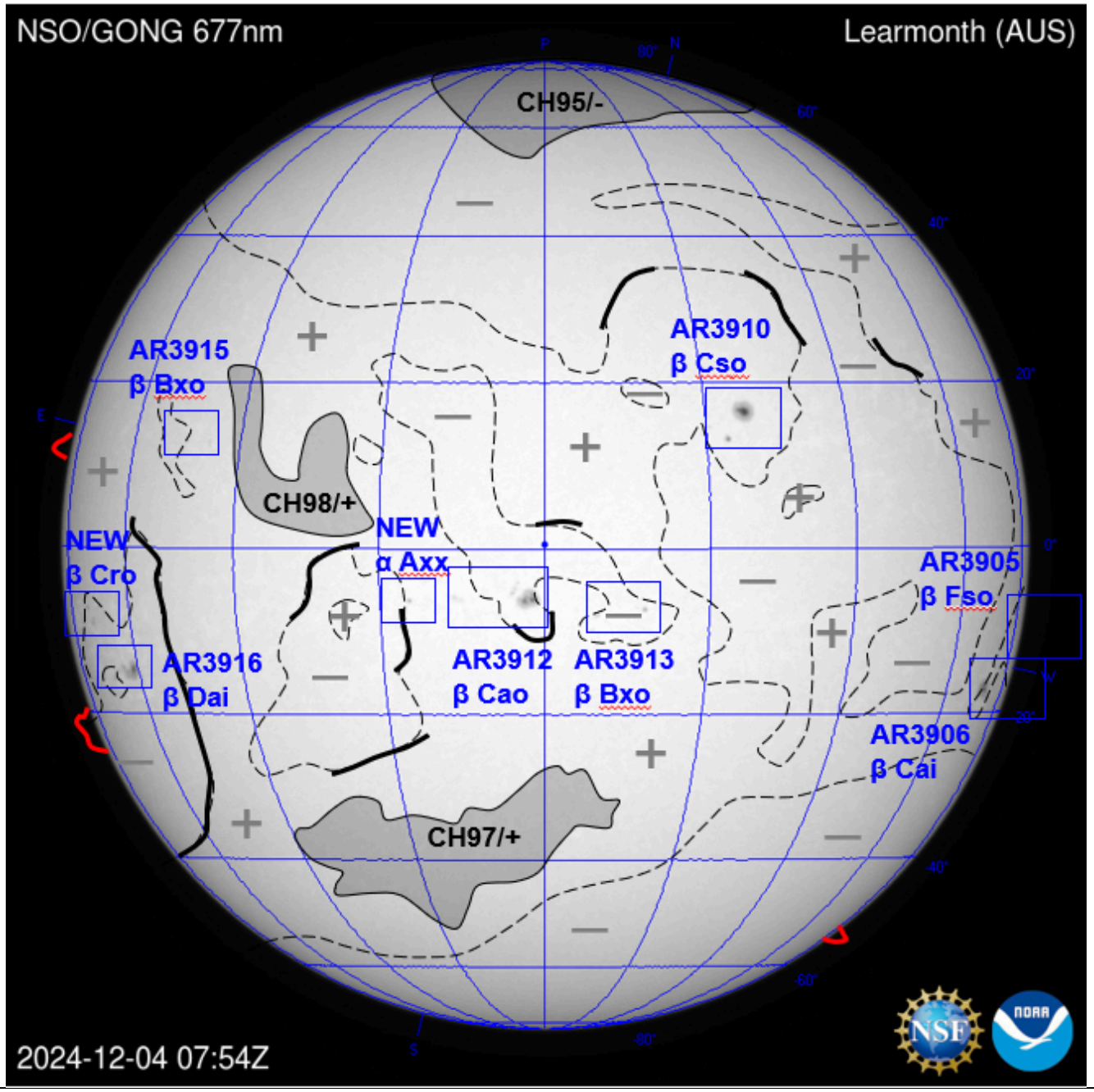
Figure 1: Solar Synoptic Map 04/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no Earth-directed CMEs. However there are a number of filaments on the Earth-facing disc, including a very large north-south orientated filament in the east which will be monitored as it moves more into the Earth-Sun line later in the period.

Slightly elevated solar winds at first (around 450km/s), are expected to ease a little to become background (below 400km/s). There are no fast wind connections anticipated in the period with CH98/+ currently too far east for this period, and CH97/+ considered too far south. This is despite MOSWOC Enlil connecting Earth to the northern edge of the HSS from CH97/+ from 05 Dec. This a persistent feature that was further north on the previous rotation and yet had no perceptible influence on the observed solar winds, and is subsequently not expected to be observed on this occasion.

Geomagnetic activity is forecast to be Quiet with isolated Unsettled intervals.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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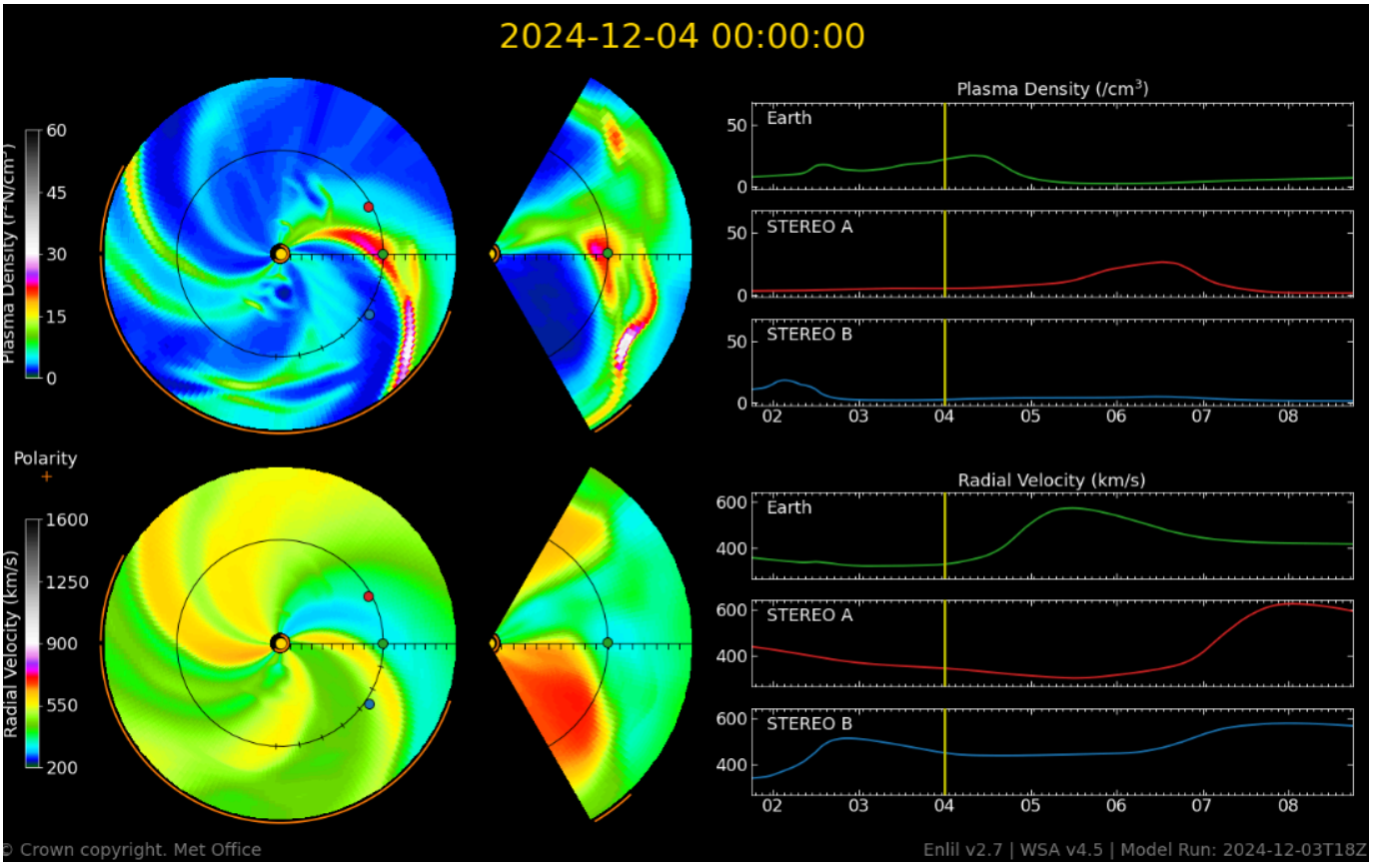
Figure 2: MOSWOC ENLIL. Strong enhancement to the south is likely too early and extends too far north, with ENLIL providing poor guidance beyond 05 Dec.



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Radio Blackouts - X-Ray Flares

Solar activity has been Low to Moderate over the past 24 hours, with an isolated M-class flare peaking at M2.3 at 04/1001 UTC from a region just beyond the east limb.

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Low to Moderate activity is forecast, with a chance of further isolated M-class flares.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	50	50	50	50
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 3: GOES SUVI 304 and 195 showing the potential complexity coming around the SE limb.

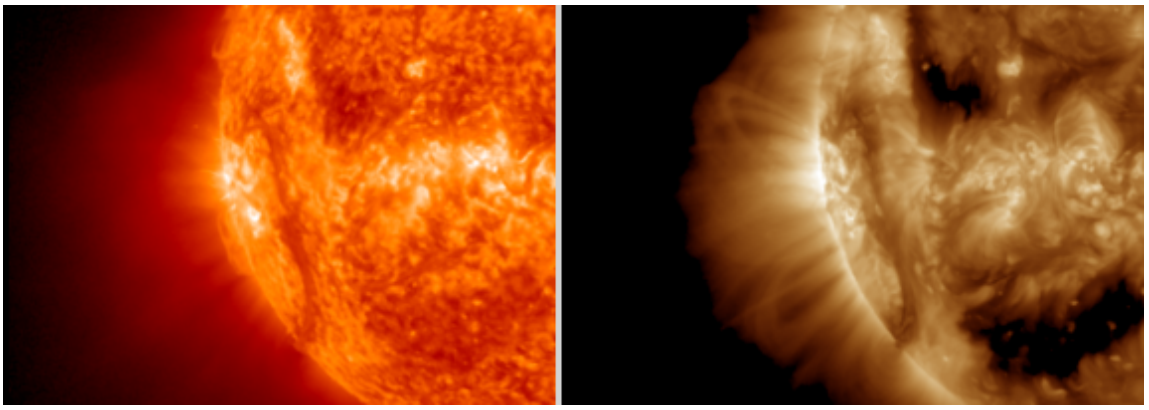

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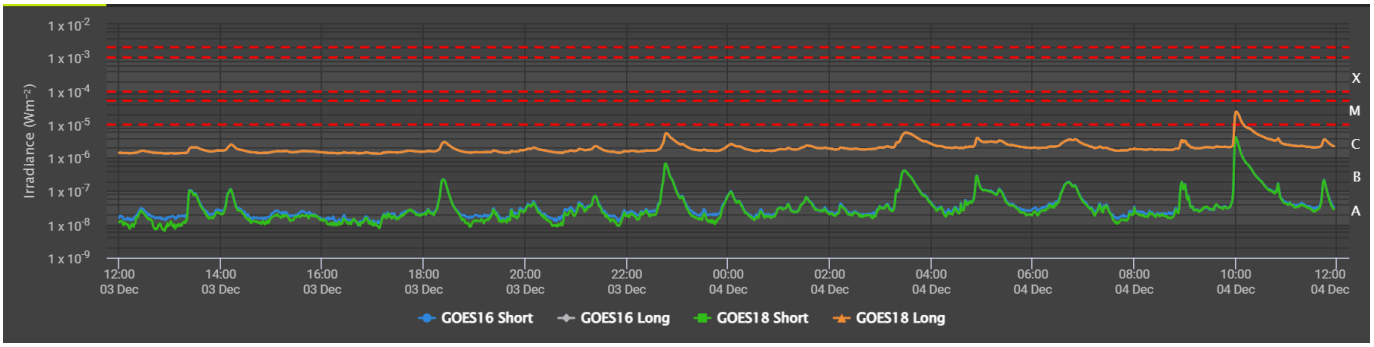
Figure 4: GOES-16/18 X-ray flux



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Solar Radiation Storms (High Energy Protons)

GOES-18 Proton flux is currently at background. While there are a couple of moderately sized regions on the better connected western disc, these are relatively simple and inactive. Along with the other regions on the disc also being relatively small and simple, this only gives a very slight chance of high energy proton enhancement through this period.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy Electron flux observed by GOES-16 is at Background. This is expected to persist, with no significant coronal hole or CME enhancements currently anticipated during the forecast period.

The associated 24 hr fluence is expected to persist below Active levels, with MOSWOC REFM currently considered to be providing good guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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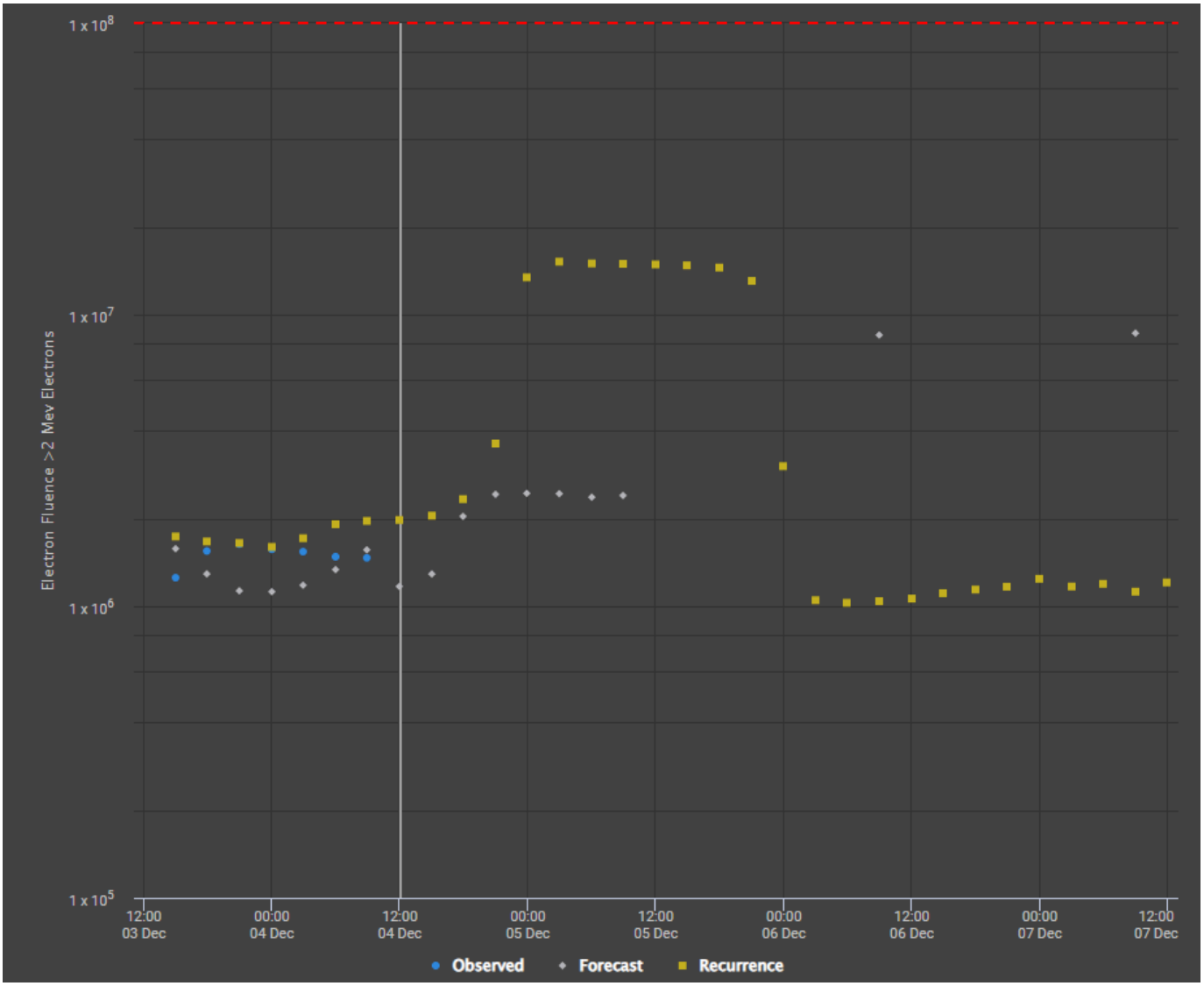
Figure 5: MOSWOC REFM latest output



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